◆ FISH AND WILDLIFE HARVEST

INTRODUCTION

Many Central Valley fish and wildlife species whose populations are declining are not harvested commercially or recreationally (e.g., delta smelt). This suggests that underlying problems with ecosystem processes and functions and habitat conditions throughout the Bay-Delta watershed are primary causes of the decline.

For many populations, it is highly likely that harvest restrictions, in the absence of an integrated ecosystem management program, will have little benefit in the long-term sustainability of these species.

Under current harvest levels, harvest is not a stressor limiting populations of waterfowl and upland game in the Bay-Delta. Proposed restoration of wetland and upland habitats is expected to increase resident and wintering waterfowl and upland game populations. However, the Ecosystem Restoration Program Plan (ERPP) anticipates that harvest levels would also increase in response to increased species abundance. Opportunities for increased access for public hunting may also increase as a result of some proposed actions. For example, restoration of wetland and upland habitats would involve acquiring lands through conservation easements or purchase from willing sellers and, depending on the conditions of such agreements, access for hunting may be provided.

Harvest management tools include regulations that control daily and seasonal bag limits, size limits, limits based on sex, gear restrictions, and open and closed harvest seasons based on time or location.

STRESSOR DESCRIPTION

Controlling harvest, in and of itself, is unlikely to restore fish and wildlife populations to a sustainable healthy state. The present harvest management processes are sufficient to protect species and allow population increases by restoring ecological processes that create and maintain habitats. The possible exception is related to chinook salmon and modestly reducing harvest of this species may make a significant contribution to restoring populations to desired levels. ERPP visions for chinook, salmon, steelhead, and striped bass emphasize reactivating or improving ecosystem processes that create and maintain the habitats that support fish and wildlife populations. Conservative harvest strategies during the period when habitats are being restored will accelerate the rebuilding of fish and wildlife populations.

SALMON HARVEST

In addition to applying the principles of traditional harvest management, it is necessary to consider the complexities of the interactions and dependencies between harvest, health of habitat, and the overall productivity of individual salmon populations. Harvest influences salmon productivity by reducing the number of adult fish in the spawning population, the age structure of the spawning population, and the overall fecundity (fertility) of the population because older female fish are generally larger and carry more eggs. In a much broader perspective, harvest management should strive to protect the productive capacity of individual salmon stocks by pursuing the reasonable and essential objective of protecting the genetic diversity of salmon populations upon which production ultimately depends.

Extensive ocean recreational and ocean commercial troll chinook salmon fisheries exist along the California central coast, and an inland recreational fishery exists in the Central Valley. Support of these economic and recreational uses is an important component in the overall effort to restore and maintain ecological health of the Central Valley ecosystem. Elimination of chinook salmon harvest will not restore ecological health to the system. Likewise, restoring ecological processes in the absence of conservative short-term harvest management may not provide for a sufficiently rapid rebuilding of naturally spawning chinook stocks. However, past observations indicate that Central Valley chinook populations have the ability to rapidly increase in size when there are the required riverine habitat conditions and sufficient flows for juvenile rearing and emigration.

Overall chinook salmon harvest rates must be consistent with the ERPP goal of rebuilding important salmon stocks as evaluated using the Cohort Replacement Rate method. Generally, stable chinook populations will exhibit a long-term average cohort replacement rate of 1.0. During rebuilding (which may require 10-15 years), harvest and inland conditions will be improving and rebuilding will require an average replacement rate greater than 2.0 for the less abundant runs such as the winter run and spring run.

One harvest strategy may be to implement a selective ocean fishery for hatchery stocks to reduce the harvest of naturally produced stocks. This would require the mass marking of all hatchery chinook produced at Central Valley hatcheries and perhaps in the Klamath basin, Trinity basin, and southern Oregon. Another, and perhaps more realistic option, may be to consider economic incentives for commercial and charterboat operators, as well as local businesses dependent on fishing to offset negative economic impacts associated with highly restrictive fishing.

Before 1986, harvest rates were estimated at 65-75% (PFMC 1996), which may have been too high to support a sustainable fishery. Beginning in 1986, harvest rates increased coincidently with the closure of the fishery north of Fort Bragg, California. This fishery was closed to meet harvest-sharing obligations on Klamath River stocks to Native American Tribes. This closure shifted the ocean troll fishery south to the Central Valley index area.

Many conservation biologists believe that a harvest rate of about 67% is a sustainable, conservative level for naturally spawning stocks, if quality habitat conditions exist inland. Hatchery-produced stocks can support higher rates, but sustaining high rates in the ocean mixed-stock chinook fishery also requires high harvest of naturally produced stocks.

In 1996, the Pacific Fishery Management Council (PFMC) increased the minimum size limits and decreased season length in both recreational and commercial fisheries. These actions were implemented to reduce the fishery impacts on winter-run chinook salmon by 50%. Reducing harvest is one of several major elements that will contribute in both the short and long term to restoring healthy fish populations, but it will not contribute to restoring health of important ecological processes, functions, and habitat. According to available information, it appears that a sustainable chinook salmon fishery can be maintained if habitat conditions and ecosystem processes are restored throughout the Bay-Delta watershed, and if the ocean harvest index on naturally produced fall-run chinook salmon stocks is reduced by 10% below present levels.

Alternative actions that may support harvest reductions include a selective fishery that targets only externally marked chinook salmon and that releases unmarked fish. Selective fisheries can reduce harvest rates on unmarked fish by as much as 70-80% for gear types with low release and dropoff (shaker) mortality rates. However, the reduced harvest rates can be as little as 10-50% for gear types with high release and dropoff mortality rates. The application and benefits of a selective fishery for the central California coast ocean mixed-stock fishery are unknown. The potential effectiveness of a selective fishery in increasing spawning escapements of unmarked fish depends on the following factors:

- the proportion of a naturally spawning stock that would be harvested by the fishery in the absence of selective regulations,
- the impact of nonselective fisheries that harvest unmarked fish that are released in selective fisheries,

- the degree to which reduction in total abundance caused by mortality resulting from application of tags or other distinguishing marks increases harvest rates in nonselective fisheries that operate under catch quotas or bag limits, and
- the magnitude of harvest rate reductions resulting from the selective fishery.

In addition to considering the potential implementation of a mass marking and selective fishery along the California coast, ERPP is also considering the feasibility of providing economic incentives for commercial and charterboat operators to offset negative economic effects of short-term reduced harvest.

Attainment of the ERPP vision for chinook salmon harvest will rely on actions by the California Fish and Game Commission and PFMC. PFMC and seven other regional councils were created by the Magnuson Fishery Conservation and Management Act in 1976. Their primary role is to develop, monitor, and revise management plans for fisheries conducted within 3 to 200 miles of the United States coast. PFMC develops plans for ocean fisheries off California, Oregon, and Washington.

The ocean salmon fisheries off Washington, Oregon, and California have been managed by the PFMC since 1977 by using Fishery Management Plans (FMP). Since the beginning of the 1985 season, the ocean salmon fishery has been managed by a framework FMP that allows flexibility to adjust annual regulations in response to varying stock abundance.

The framework FMP contains fixed management objectives and goals that guide the PFMC's choice of flexible annual management measures. Within specified limits, PFMC may vary season length, management boundaries, bag limits, gear restrictions, and quotas annually to achieve the fixed objectives of the FMP. Some of the major provisions of the FMP are a description of the salmon stocks comprising the management unit, management objectives, and escapement goals and procedures for determining and allocating ocean harvests and in-season management procedures.

It is important to distinguish ERPP's vision for chinook salmon and the roles and responsibility of other management authorities, particularly PFMC. Although ERPP provides a long-term comprehensive plan to restore the ecosystem health of the Bay-Delta system, the harvest management objectives of PFMC are to:

- establish ocean harvest rates for commercial and recreational fisheries that are consistent with requirements for optimum spawning escapements, treaty obligations, and continuance of established recreational and commercial fisheries within the constraints of meeting conservation and allocation objectives.
- minimize fishery mortalities for those fish not landed from all ocean salmon fisheries as consistent with optimum yield;
- manage and regulate fisheries so the optimum yield encompasses the quantity and value of food produced and the recreational, social, and economic values of the fisheries;
- develop fair and creative approaches to managing fishing effort and evaluate and apply management systems as appropriate to achieve these management objectives;
- achieve long-term coordination with the member states of PFMC, the treaty Native American tribes, and management entities that are responsible for salmon habitat or production in the development of a coastwide salmon management plan;
- manage in a manner consistent with any United States-Canada salmon treaty; and
- support the enhancement of salmon stock abundance in fishing-effort management programs to facilitate a return to economically viable and socially acceptable commercial, recreational, and tribal seasons.

In addition to its management objectives, PFMC has established a set of conservation goals, many of which are consistent with ERPP. In recognizing that maintenance of a healthy resource is necessary to achieve continuing benefits to the nation, PFMC will adhere to the following conservation goals:

- Assume a more aggressive role in protecting and enhancing anadromous and marine fish habitat. PFMC will play a leadership and coordination role to support the agencies having management responsibilities and authorities.

- Manage for viable salmon stocks and maintain genetic diversity. PFMC recognizes that in areas of importance to particular stocks, habitat degradation and water development may leave no alternative but to manage for hatchery production or a combination of hatchery and natural production.
- Strengthen its efforts to work with other jurisdictions, both domestic and international, to manage stocks of fish over their entire range.
- Strongly support development of concepts and practices for managing mixed-stock and multispecies complexes and rebuild those complexes to best meet the economic and allocation objectives of PFMC.
- Support additional data collection and analyses that will improve the basis for management measures.
- Develop management measures that constrain incidental catches of fish and other animals within acceptable limits while target species are being harvested.

STEELHEAD TROUT HARVEST

The harvest of both naturally and hatchery- produced juvenile steelhead takes place throughout the Sacramento basin. Juvenile harvest is not desirable because it reduces the future adult population size, the opportunity for anglers to harvest adult steelhead, and the overall productivity and fecundity of spawning populations.

More restrictive angling regulation may be necessary to protect steelhead from overharvest and still allow anglers the opportunity for continued sport fishing. The following elements might be considered as additional protective measures for steelhead: catch-and-release fishing only, catch-and-release fishing where hooked fish are not removed from the water to decrease handling mortality, size limits to protect either juvenile fish or larger adult spawners, and barbless hooks to reduce latent mortality.

ERPP supports special recognition of the steelhead fishery of the Yuba River as an important wild steelhead fishery. As part of this recognition, regulations should be enacted to protect this valuable stock while allowing controlled angling opportunities that have a minimal adverse effect on the spawning population. ERPP also supports prohibiting the harvest of juvenile steelhead and rainbow trout in the Yuba River while providing anglers with opportunities for catch-and-release fishing for wild steelhead in other streams.

STRIPED BASS HARVEST

Adult striped bass support the most important sport fishery in the Sacramento-San Joaquin estuary, and the condition of this fishery is publicly recognized as a barometer of the status of the estuary and its biological resources. Statewide, more than 400,000 anglers fish for striped bass and most of this effort is directed at the Sacramento-San Joaquin estuary population. Unfortunately, because of the depressed state of the population, the present annual harvest of striped bass from the Sacramento-San Joaquin system is only about 80,000 fish. Recent annual harvest rates have ranged from 9-14%. In the early 1970s, when striped bass were more abundant and more anglers fished, harvest rates of 16-24% led to the harvest of more than 300,000 legal-sized fish annually. Annual harvest may have reached 750,000 fish from the high populations of the early 1960s.

ERPP supports the legal harvest of striped bass because it has not caused the decline in abundance that has occurred since the 1960s and 1970s. At the same time, efforts to curtail illegal harvest (taking undersized fish and catching over limits) should be vigorously continued. The goal of increased legal harvest should be attained by maintaining present angling regulations while increasing the abundance of adult fish. Although angler participation most likely will expand as fishing success increases, it is anticipated that present angling regulations will keep harvest rates at sustainable levels (<20%).

WHITE STURGEON HARVEST

White sturgeon provides for an important recreational fishery in the Bay-Delta. Although, commercial fishing for sturgeon is prohibited in California, historical accounts indicate that commercial fisheries greatly reduced west coast sturgeon populations, including the Sacramento-San Joaquin population, in the late 1800s. As a result, all sturgeon fishing was prohibited in 1917; the fishery was reopened in 1954 to sport angling only. With the exception of 1956 to 1963, when the minimum size limit was raised to 50-inch total length (TL), the sport fishery had the same regulations from its inception until 1989: a year-round season, 40-inch TL minimum size limit and a one-fish-per-day creel limit.

Although fluctuations in legal-sized white sturgeon abundance have been primarily dependent on variable recruitment, historical depletion by the commercial fishery indicates that the population is readily subject to overharvest. Consequently, a 40% increase in the average annual harvest rate from 7% in the 1960s and 1970s to 10% in the 1980s was cause for concern and was the impetus for angling regulation changes in the early 1990s. Starting in 1990, a maximum size limit of 72 inches was instituted and the minimum size limit was increased in 2-inch annual increments until it reached 46 inches in 1992. This slot limit is designed to protect older, more productive fish and younger fish that will be recruited into the spawning population and also to reduce overall harvest.

These angling regulations have achieved their purpose; estimated harvest rates have been <3% in recent years. Therefore, ERPP envisions supporting the present harvest strategy that protects the white sturgeon from overexploitation while providing anglers with a sustainable trophy fishery.

Harvest of Wildlife

Under current harvest levels, harvest is not a stressor limiting populations of waterfowl and upland game in the Bay-Delta. Because proposed restoration of wetland and upland habitats is expected to increase resident and wintering waterfowl and upland game populations, however, ERPP anticipates that harvest levels would also increase in response to increased species abundance. Opportunities for increased access for public hunting may also increase as a result of some proposed actions. For example, restoration of wetland and upland habitats would involve acquiring lands through conservation easements or purchase from willing sellers and, depending on the conditions of such agreements, access for hunting may be provided.

Illegal Harvest of Fish and Wildlife

The illegal harvest of fish and wildlife is known to be a problem throughout the Bay-Delta watershed. It may range from the illegal take of adult spring-run chinook salmon from their oversummering habitats in the upper sections of stream tributary to the Sacramento River, to the illegal take of undersized striped bass in the Delta. Illegal harvest can also be in the nature of a more commercial activity such as using gillnets to catch adult salmon, sturgeon, and striped bass in the Delta for sale and profit.

By its very nature, illegal harvest is difficult to control or eliminate. ERPP envisions that the California Fish and Game Code will be enforced by increasing law enforcement officer staff and that reductions in the illegal take of fish and wildlife could make important contributions in rebuilding depleted stocks. ERPP also envisions that directed enforcement is only one avenue to reduce illegal harvest and that a strong public education program is critical to the success of the enforcement effort.

Vision

The vision for fish and wildlife harvest is to support strategies that maintain a sustainable commercial and recreational chinook salmon fishery in a manner consistent with the recovery; of individual stocks; steelhead trout harvest strategies that fully protect naturally spawning stocks while redirecting harvest to hatchery-produced stocks; the continued legal harvest of striped bass and reduction of illegal harvest; and the present white sturgeon harvest strategy, which protects the species from overexploitation while providing a sustainable trophy fishery.

The vision for salmon harvest is to implement strategies that support and maintain sustainable commercial and recreational fisheries. Achieving this vision would be consistent with ecosystem restoration and recovery of endangered species and species of special concern. ERPP proposes both short-term and long-term strategies for harvesting chinook salmon.

The short-term strategy is to support the rebuilding of chinook salmon stocks to desired levels by reducing harvest of naturally produced fish.

The long-term strategy is to increase chinook salmon populations by restoring important ecosystem processes and reducing or eliminating stressors that cause direct and indirect mortality. In the long-term vision, ERPP anticipates sustainable ocean commercial harvest landings of 750,000 to 1,500,000 chinook salmon and recreational landings of 500,000 to 750,000 per season.

The vision for steelhead trout is to support harvest strategies that fully protect naturally spawning stocks while redirecting harvest to hatchery-produced stocks. This will require a marking program similar to the mass marking program proposed for chinook salmon, except the number of fish to mark would be lower. In this vision, adult steelhead harvest would be directed to steelhead produced at Coleman National Fish Hatchery on Battle Creek, Feather River Hatchery on the Feather River, Nimbus Hatchery on the American River, and Mokelumne River Fish Installation on the Mokelumne River. Harvest of these stocks would also occur on the mainstem of the Sacramento River.

The vision for striped bass harvest is to support artificial production needed to sustain annual recreational harvest of about 20% of the adult population. The vision for striped bass is closely integrated with visions for other ecosystem elements that will contribute to higher survival of resident, estuarine, and anadromous fish. This higher survival will be achieved through extensive habitat restoration, reduction or elimination of stressors, and the reactivation of ecological processes that create and maintain habitats.

The vision for white sturgeon is to support the annual recreational harvest of less than 3% of the adult population which will protect population while providing opportunity for a trophy fishery. The vision for white sturgeon is also closely linked to the visions for Central Valley streamflows, habitat improvement, and the reduction of elimination of stressors that cause direct and indirect mortality to young fish.

The vision for illegal harvest is that increased enforcement efforts and public education will reduce the adverse effects to a level consistent with restoring fish and wildlife populations.

INTEGRATION WITH OTHER RESTORATION PROGRAMS

Three major programs to restore chinook salmon and steelhead populations exist within the Central Valley.

- The Secretary of the Interior is required by the Central Valley Project Improvement Act to double the natural production of Central Valley anadromous fish stocks by 2002 (USFWS 1997).
- The National Marine Fisheries Service is required under the federal Endangered Species Act to develop and implement a recovery plan for the endangered winter-run chinook salmon and to restore the stock to levels that will allow its removal from the list of endangered species (NMFS 1997).
- The California Department of Fish and Game is required under State legislation (The Salmon, Steelhead Trout and Anadromous Fisheries Program Act of 1988) to double the numbers of salmon and steelhead trout that were present in the Central Valley in 1988 (Reynolds et al. 1993, McEwan and Jackson 1996).

In addition the Fish and Game Commission adopts regulations for the harvest of fish and wildlife, sets seasons, bag limits, closed areas, gear restrictions and a variety of other tools to control the harvest of fish and wildlife species. The Pacific Fishery Management Council annually sets harvest regulations for the areas along the Pacific Coast south of British Columbia.

LINKAGE WITH OTHER ECOSYSTEM ELEMENTS

One of the most important components of the ERPP is restoring health to fish populations in the ERPP Study Area. Some of these species, such as winter-run chinook salmon, are State or federally listed endangered species. Others species, such as splittail and steelhead, are species of concern, and spring-run chinook salmon is designated a monitored species by the Fish and Game Commission. Overall health of fish and wildlife species is closely linked to the health of ecological processes that create and maintain habitats needed by these species. Improving the ecological functions will also improve habitat. Concurrently, a reduction or elimination of stressors will contribute to improved functions, habitats, and species.

OBJECTIVES, TARGETS, ACTIONS, AND MEASURES

The Strategic Objectives for harvest of fish and wildlife are to enhance, to the extent consistent with ERP goals, population of waterfowl and upland game for harvest by hunting and for non-consumptive recreation; maintain, to the extent consistent with ERP goals, fisheries for striped bass, American shad, signal crayfish, grass shrimp, and non-native warmwater gamefishes, and enhance fisheries for salmonids, white sturgeon, Pacific herring, and native cyprinid fishes.

LONG-TERM OBJECTIVE: Efforts by CALFED will need to be integrated into the Pacific Fishery Management Council (PFMC) and the National Marine Fishery Service (NMFS) objectives to manage chinook salmon species with-in and adjacent-to the California coast with regards to harvest limits and regulations. Other anadromous species like the white sturgeon and striped bass will need to meet the long-term goals established in the CVPIA and DFG's Anadromous Fish Restoration Plan for their respective species. Maintain self-sustaining populations of native wildlife so that opportunities exist for viewing and hunting throughout the ERPP study area.

SHORT-TERM OBJECTIVE: Areas within the Sacramento-San Joaquin Estuary and watershed will be evaluated to determine extent of illegal harvest and exploitation rates for all gamefish and terrestrial species that reside within the ERPP Study area. This information will then be used to develop and refine current management plans and restoration efforts.

RATIONALE: Many of the fishing limits established in the ocean off the coast of California are regulated by the U.S. Department of Commerce under recommendations from the PFMC. Changes or alteration to these regulations would be implemented through the PFMC meetings under the Magneson Act. The level of illegal harvest is not well known for all species of aquatic species throughout California. In addition, the exploitation/harvest rate for many of the popular game species (white sturgeon, striped bass, largemouth bass, and white catfish) is documented.

RESTORATION ACTIONS

The general target is to control harvest in a manner which contributes to attainment of fish population goals established by State and federal legislation and in a manner consistent with restoration of ecosystem health.

Actions which will contribute to this vision include:

- Adaptive management and focused research programs to mark hatchery produced chinook salmon to provide harvest and return data to better manage harvest.
- Reduce ocean harvest rates to 40-50%.
- Mark all hatchery produced steelhead and evaluate the benefits of implementing a selective fishery which targets only marked fish.
- Provide special recognition to the Yuba River as an important wild steelhead fishery.
- Augment the striped bass population and recreational fishery by artificial production.
- Maintain the existing regulations for the white sturgeon trophy fishery.
- Increase enforcement efforts directed at illegal harvest.
- Develop a public education program designed to reduce the illegal harvest of fish and wildlife in the ERPP Study Area.

MSCS CONSERVATION MEASURES

The following conservation measures were included in the Multi-Species Conservation Strategy (2000) to provide additional detail to ERP actions that would help achieve species habitat or population targets.

- To the extent consistent with CALFED objectives, reduce losses of adult splittail spawners during their upstream migrations to recreational fishery harvest.

- Implement applicable management measures identified in the restoration plan for the Anadromous Fish Restoration Program and the recovery plan for the native fishes of the Sacramento/San Joaquin Delta.
- Implement management measures identified in the proposed recovery plan for the Sacramento River winter-run chinook salmon.

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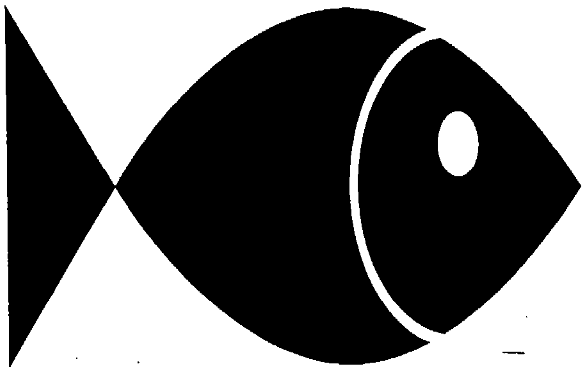
◆ ARTIFICIAL FISH PROPAGATION



INTRODUCTION

The Ecosystem Restoration Program Plan (ERPP) recognizes that artificial propagation of fish has been an important tool used by salmon managers in the Central Valley for over a century. The intended goal of hatchery operation has consistently been for mitigation—typically for the non-retrievable loss of valuable migration, holding, spawning, rearing, and emigration habitats that were cut off by large dams throughout the Central Valley.

Hatchery production makes a significant contribution to commercial and sport fisheries as well as their role in providing mitigation for loss of habitats from the construction of large dams. ERPP envisions the integration of an effective management program of existing or new hatchery facilities with harvest and population management strategies that will work together to restore and sustain the health of fish species dependent on the Bay-Delta. In addition, the artificial propagation of striped bass would be an interim measure to provide for the maintenance of a healthy population and valuable sustainable sport fishery until such time that striped bass are capable of sustaining naturally spawning population levels present in the late 1960s and early 1970s (approximately three million adults).

STRESSOR DESCRIPTION

Five hatcheries currently produce chinook salmon in the Central Valley. The three largest hatcheries (Coleman, Feather River, and Nimbus) are in the Sacramento River Basin (see table), and the Mokelumne and Merced River hatcheries are in the San Joaquin Basin. Most of these salmon hatcheries were constructed between 1940 and 1970 as mitigation for specific dams and water projects, and are funded by mitigation agreements with State, federal, and public agencies and monies collected from commercial salmon fishers.

Before 1967, Nimbus and Coleman were the only hatcheries with substantial production rates, but between 1967 and 1991, total Central Valley salmon production nearly doubled. Central Valley hatcheries now produce an annual average of nearly 33 million juvenile fall-run chinook, more than one million juvenile spring-run chinook, about 0.6 million juvenile late-fall-run chinook, and more than 2.5 million juvenile steelhead.

Releasing large numbers of hatchery fish, however, can pose a threat to wild chinook stocks. Potential consequences include genetic impacts on wild fish (e.g., outbreeding and inbreeding), competition for food and other resources between wild and hatchery fish, predation of hatchery fish on wild fish, and increased fishing pressure on wild stocks as a result of hatchery production (Waples 1991). Potential impacts to native gene pools must be evaluated in light of evidence for genetic changes in hatchery stocks (e.g., random genetic drift, selection, stock transfers, and straying), which can determine the nature and magnitude of interactions between hatchery and wild fish.

There is little evidence with which to evaluate past and current genetic impacts of Central Valley salmonid hatchery programs on the naturally spawning chinook salmon and steelhead populations. Bartley and Gall (1990), using protein electrophoresis, found that populations of chinook salmon from Central Valley hatcheries were genetically similar to wild populations and speculated that the releasing hatchery fish in the Delta may have resulted in abnormally high straying and gene flow to native stocks. However, the great genetic similarity among all Central Valley chinook populations makes it difficult to detect genetic impacts from hatchery releases. An alternative hypothesis that cannot be

Central Valley Salmon and Steelhead Production Hatcheries and the Average Annual Production of Chinook Salmon and Steelhead

		Average Annual Production				
		Chinook Salmon Stock				
Facility[1] and Period of Record	Location	Fall	Spring	Late-Fall	Winter	Steelhead
Feather River Hatchery (1968-1993)	Feather River	7,434,000	1,219,000[2]	N.P.[3]	N.P.	751,000
Nimbus Hatchery (1965-1993)	American River	8,810,000	N.P.	N.P.	N.P.	767,000
Mokelumne River Hatchery (1965-1993)	Mokelumne River	946,000	N.P.	N.P.	N.P.	161,000
Merced River Hatchery (1970-1993)	Merced River	579,000	N.P.	N.P.	N.P.	N.P.
Coleman National Fish Hatchery (1940-1993)	Battle Creek[4]	14,941,000	N.P.	639,000	26,000	814,000
Sum of average statewide production		32,710,000	1,219,000	639,000	26,000	2,493,000

1 All facilities are operated by the California Department of Fish and Game, except that Coleman National Fish Hatchery is operated by the U.S. Fish and Wildlife Service.

2 Spring-run chinook propagated at Feather River Hatchery are believed to have interbred with fall-run chinook.

3 N.P. = not produced.

4 Battle Creek is a tributary of the Sacramento River.

disproved with present data is that Central Valley hatchery stocks have diverged little from their wild ancestors, in which case the near-term genetic impacts of hatchery programs might be minimal. DNA studies may shed light on this problem (Nielsen et al. 1994).

The general literature on the genetic impacts of artificial propagation programs on Pacific salmonids suggests that Central Valley hatcheries could have serious, direct and indirect, negative effects on the naturally spawning chinook salmon and steelhead. Straying hatchery fish, for example, is a major cause of hybridization between hatchery and wild fish (Waples 1991). Although straying, primarily among neighboring streams, is a natural phenomenon, hatchery fish have been documented to stray farther and at a higher rate than wild fish. In the Central Valley, two hatchery practices in particular might contribute to elevated straying levels: trucking smolts and yearlings to distant sites for release and transferring eggs and young fish between hatcheries. These are both practiced at Feather River and Nimbus hatcheries.

Increased production and survival of hatchery chinook salmon have resulted in increasing contributions of hatchery fish to adult spawning escapements since 1967. When hatcheries are successful at producing adult fish, the potential harvest rate may become very high. Fewer adults are needed to maintain a hatchery run because of high survival from eggs to smolts under hatchery conditions. This plants high percentages of returning hatchery fish to be harvested while still sustaining the hatchery run. As harvest rates are raised to match the potential productivity of hatchery stocks, wild stocks may become overfished.